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glidæ of the *Distegi*, with which they are generally arranged, and, on the other, to the *Blenniidæ.* Some of the latter elongate the basal pectoral bones considerably, and lead to the *Batrachidæ* on the one side, where the number of these bones is increased, and on the other to the *Pediculati*, where the number is diminished. To these groups the *Anacanthini* and *Heterosomata* are less allied.

The third upper pharyngeal bone has already presented an increase of mass and use in the first orders of Physoclysti with ventral fins. Among the *Percomorphi* the same increase makes its appearance by little beginnings in some *Sciaenidæ.* It is quite noteworthy in most of the *Carangidæ*, a group whose separation from the *Scombridæ* by Günther is supported by this part of their organism. Through forms not now specified, approach to the *Pharyngognathi* is made. Here the pharyngeals are modified into a mill-like structure, which is least specialized in the *Embiotocidæ*, and most so in the *Scaridæ.*

Mr. F. W. PUTNAM was not prepared to accept all the changes that were proposed by Prof. Cope, some of which were somewhat radical. At the same time, however, he regarded it as the nearest approach to a correct classification of the fishes that had ever been made. The points of distinction between the fishes and batrachians had never been better made, nor in a more unexpected manner. He thought Professor Cope had found the only means by which one can with certainty distinguish a fish from a batrachian. The way in which a number of the families had been grouped together he fully approved of, though some of the groups he thought still open to question.

THE LAWS OF ORGANIC DEVELOPMENT.—BY PROF. E. D. COPE.

THE discussion of this subject divides itself into two parts, viz.: a consideration of the proof that evolution of organic types, or descent with modification has taken place; and, secondly, the investigation of the laws in accordance with which this development has progressed.

I. ON THE PROOF FOR EVOLUTION.

There are two modes of demonstration, both depending on direct observation. One of these has been successfully presented by Darwin. He has observed the origin of varieties in animals and plants, either in the domesticated or wild states, and has shown, what had been known to many, the lack of distinction in the grade of difference which separate varieties and species. But he has also pointed out that species (such, so far, as distinctness goes) have been derived from other species among domesticated animals, and he infers by induction that other species, whose origin has not been observed, have also descended from common parents. So far I believe his induction to be justified; but when from this basis evolution of divisions defined by important structural characters, as genera, orders, classes, etc., is inferred, I believe that we do not know enough of the uniformity of nature's processes in the premises to enable us to regard this kind of proof as conclusive.

I therefore appeal to another mode of proving it, and one which covers the case of all the more really structural features of animals and plants.

It is well known that in both kingdoms, in a general way, the young stages of the more perfect types are represented or imitated with more or less exactitude by the adults of inferior ones. But a true identity of these adults with the various stages of the higher has, comparatively, rarely been observed. Let such a case be supposed.

In *A* we have four species whose growth attains a given point, a certain number of stages having been passed prior to its termination or maturity. In *B* we have another series of four (the numbering a matter of no importance), which, during the period of growth, cannot be distinguished by any common, *i. e.*, generic character, from the individuals of group *A*, but whose growth has only attained to a point short of that reached by those of group *A* at maturity. Here we have a parallelism, but no true evidence of descent. But if we now find a set of individuals belonging to one species, and therefore held to have had a common origin or parentage (or still better the individuals of a single brood), which present differences among themselves of the character in question, we have gained a point. We know in this case that the individuals, *a*, have attained to the completeness of character presented by group *A*, while others, *b*, of the same parentage have only attained to the structure of those of group *B*. It is perfectly obvious that the individuals of the first part of the family have grown further, and, therefore, in one sense faster, than those of group *b*. If the parents were like the individuals of the more completely grown, then the offspring which did not attain that completeness may be said to have been *retarded* in their development. If, on the other hand, the parents were like those less fully grown, then the offspring which have added something have been *accelerated* in their development.

I claim that a consideration of the uniformity of nature's processes, or inductive reasoning, requires me (however it may affect the minds of others) to believe that the groups of species whose individuals I have never found to vary, but which differ in the same point as those in which I have observed the above variations, are also derived from common parents, and the more advanced have been *accelerated* or the less advanced *retarded*, as the case may have been with regard to the parents.

This is not an imaginary case, but a true representation of many which have come under my observation. The developmental resemblances mentioned are universal in the animal and probably in the vegetable kingdoms, approaching the exactitude above depicted in proportion to the near structural similarity of the species considered.

Example 1.—It is well known that the *Cervidæ* of the Old World develop a basal snag of the antler (see Cuvier, Ossemens Fossiles, and Gray, Cat. British Museum,) at the third year; a majority of those of the New World (genera Subulo, Cariacus) never develop it except in abnormal cases in the most vigorous maturity of the most northern Cariacus (*C. Virginianus*), while the South American Subulo retains to adult age the simple horn or spike of the second year of all *Cervidæ.*

Among the higher *Cervidæ*, Rusa and Axis never assume characters beyond an equivalent of the fourth year of Cervus. In Dama the characters are, on the other hand, assumed more rapidly than in Cervus, its third year corresponding to the fourth of the latter, and the development in after years of a broad plate of bone, with points being substituted for the addition of the corresponding snags, thus commencing another series which terminates in the great fossil elk, Megacerus.

Returning to the American deer we have Blastocerus, whose antlers are identical with the fourth year of Cariacus. Corresponding with the Dama-Megacerus type of the Old World we have the moose (Alces) developing the same palmate horn on the basis of Cariacus (*i. e.*, without eye-snag.)

Example 2.—I select the following series, embracing the majority of the genera of the North American Helicidæ.

HELICIDÆ.

1.	Turns of spire very few; wide umbilicus: shell thin, with thin lips,	*Binneya.*
2.	Turns few, but more; rest as above,	*Vitrina.*
3.	Turns still more numerous; rest as above,	*Hyalina.*
4.	As No. 3, but lip thickened inside,	*Hygromia.*
5.	Coiled; *umbilicus closed;* lip thickened inside and out,	*Tachea* and *Pomatia.*
6.	Same, with a parietal tooth,	*Mesodon.*
7.	Same, with parietal and two interior lip teeth,	*Isognomostoma.*
	* * Recommencing at No. 4. All with open umbilicus.	
5.	As No. 4, but lip thickened in and out,	*Arionta.*
6.	Same as No. 5, but with parietal tooth,	*Polymita.*
7.	Same, with both parietal and lip teeth,	*Triodopsis.*

The successional relation of these genera may be represented in such a diagram as this:—

	Umbilicus opened.					Umbilicus closed.	
7	*						*
6		*				*	
5			*		*		
4				*			
3				*			
2				*			
1				*			

In the history of the growth of the genera Isognomostoma and Triodopsis, the extreme forms of the two series, it is well known that at first the coils of the shell are extremely few, as in Binneya; and that like it, it is very thin and with a delicately thin edge; that the turns increase successively in number, as in Vitrina and Hyalina, and that finally the lip thickens as in Hygromia. Then the umbilicus may close as in Tachea, or (in Triodopsis) remain open as in Arionta. In either case a tooth is soon added on the body whorl (Polymita, Mesodon), and finally, the full maturity of the shell is seen in the added width of the inside of the lip-margin. How many of the stages of the genera *Triodopsis* and *Mesodon* are identical with the genera of the series which represent them I leave to more thorough conchologists, but that some now exhibit and all have presented illustrations of the relation of exact parallelism I cannot doubt.

Example 1.—An abundant race of the American deer, *Cariacus Virginianus*, exists in the Adirondack region of New York, in which the development of the antlers never progresses beyond the spike stage of the second year. Therefore, some individuals of this species belong to Cariacus and some to Subulo.

Example 2.—A large part of the individuals of the common snail, *Mesodon albolabris*, never develop the tooth of the body-whorl, characteristic of the genus whose definition has to be modified to retain them.

Example 3.—Many individuals of *Triodopsis tridentata* from eastern North Carolina occur without the lip-teeth characteristic of the genus *Triodopsis.* Hence these specimens, though of common origin with others of the species, must be referred to another genus.

Example 4.—Structural characters are known in many, if not all, species which are said to be "inconstant," being present or absent indifferently, thus being useless for definition. They may be rudimental when present or considerably developed. The presence or absence of wings in some species of insects may be cited; also the presence of generic characters in the male sex of many Coleoptera and their absence in the females. The characters of males, females, workers and soldiers in bees and ants may be added. All these facts belong to the same category as those cited among deer and mollusks and have a similar explanation.

Example 5.—It does not seem to be the law in "retardation" that parallelisms exhibited by the series in its rise to its highest point of development should retrace the steps by which it attained it, and that "exact parallelisms" should be exhibited in a reversed order. Parallelisms, it is true, are exhibited; but so far as I have observed always "inexact," often in a high degree. A marked case of retardation occurs in the dental development of a number of persons who have come under my observation in the neighborhood of Philadelphia. It is not very uncommon to find persons in whom the third molars in both jaws are incomplete as to number, one, two, three, or all, being deficient. It is still more common for them to be incompletely covered by the enamel layer, and to become in consequence so worthless as to require early removal. I am acquainted with two families in which the absence of the exterior upper incisor on each side is common. In one of these the second and third generation have inherited it from the mother's side, and it now characterizes many of the children. The significance of this modification will be best understood by examining the dental structures of the *Quadrumana* in general, commencing with the highest family and the modification, we have:—

		Incisors.	Canines.	Premolars.	Molars.
Hominidæ,	Abnormal.	$\frac{1}{2}$	$\frac{1}{1}$	$\frac{2}{2}$	$\frac{2}{3}$
	Normal.	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{2}{2}$	$\frac{3}{3}$
Simiadæ,		$\frac{2}{2}$	$\frac{1}{1}$	$\frac{2}{2}$	$\frac{3}{3}$
Cebidæ,		$\frac{2}{2}$	$\frac{1}{1}$	$\frac{3}{3}$	$\frac{3}{3}$
Lemuridæ,		$\frac{2}{3}-\frac{3}{3}$	$\frac{1}{1}$	$\frac{3}{3}-\frac{2}{3}$	$\frac{3}{3}$
Mammalia, Normal.		$\frac{3}{3}$	$\frac{1}{1}$	$\frac{4}{4}$	$\frac{3}{3}$

In this table we see a decline in the number of teeth of the higher groups. Thus the premolars are one less than the nominal number in the whole order, and they lose one in each jaw in the Old World apes, and man. The molars maintain the normal number throughout, but the third in both jaws is in the *Simiadæ* reduced by the loss of a fifth or odd tubercle, thus becoming four-lobed. In the upper jaw this is first lost in the Semnopithecus; in the lower, in the next highest genus Cercopithecus. In Homo its appearance is "retarded," the interval between that event and the protrusion of the second molar—six to ten years—being relatively greater than in any genus of *Quadrumana*. Its absence is then the result of continued retardation, not of a new and adaptive suppression, and is of direct systematic zoological value.

In the incisors a reduction is also plainly visible, as we pass from the most completely furnished *Lemuridæ* to the genus Homo. One from the upper jaw is first lost, then in the *Cebidæ*, one from the lower also. The number remains the same through the *Simiadæ* and normal *Hominidæ*, but in the abnormal cases cited the process of reduction is continued and another incisor from each side disappears. That this also is truly "retardation" is also evident from the fact that the exterior incisor is the last developed, being delayed in ordinary growth a year later than those of the inner pair. The same retardation is seen in the quadrumane *Cheiromys* (the *Aye-aye*), and the whole order *Rodentia*. In the latter, the rare presence of the reduced second incisors shows that here also the external incisors are lost. This retardation is also of systematic importance, and, should either of the characters described be constant in any of the species of the genus *Homo*, would at once entitle it to new generic rank. The very frequent absence of the posterior molars (wisdom teeth) has been recently found to characterize a race in India. Should this peculiarity prove constant, this race would with propriety be referred to as a new genus of *Hominidæ*, as we have many cases of very similar species being referable to different genera. It is altogether probable that such will, at some future time, be the condition of some race or races of men.

II. ON THE LAWS OF EVOLUTION.

Wallace and Darwin have propounded as the cause of modification in descent their law of natural selection. This law has been epitomized by Spencer as the "preservation of the fittest." This neat expression no doubt covers the case, but it leaves the origin of the fittest entirely untouched. Darwin assumes a "tendency to variation" in nature, and it is plainly necessary to do this in order that materials for the exercise of a selection should exist. Darwin and Wallace's law is, then, only restrictive, directive, conservative, or destructive of something already created. Let us, then, seek for the originative laws by which these subjects are furnished —in other words, for the causes of the origin of the fittest.

The origin of new structures which distinguish one generation from those which have preceded it, I have stated to take place under the law of *acceleration.* As growth (creation) of parts usually ceases with maturity, it is entirely plain that the process of acceleration is limited to the period of infancy and youth in all animals. It is also plain that the question of growth is one of nutrition, or of the construction of organs and tissues out of protoplasm.

The construction of the animal types is restricted to two kinds of increase—the addition of identical segments and the addition of identical cells. The first is probably to be referred to the last, but the laws which give rise to it cannot be here explained. Certain it is that segmentation is not only produced by addition of identical parts, but also by subdivision of a homogeneous part. In reducing the vertebrate or most complex animal to its simplest expression, we find that all its specialized parts are but modifications of the segment, either simply or as sub-segments of compound but identical segments. Gegenbaur has pointed out that the most complex limb with hand or foot is constructed, first, of a single longitudinal series of identical segments, from each of which a similar segment diverges, the whole forming parallel series, not only in the oblique transverse, but generally in the longitudinal sense. Thus the limb of the Lepidosiren represents the simple type, that of the Icthyosaurus a first modification. In the latter the first segment only (femur or humerus) is specialized, the other pieces being undistinguishable. In the Plesiosaurian paddle the separate parts are distinguished; the ulna and radius well marked, the carpal pieces hexagonal, the phalanges well marked, etc.

As regards the whole skeleton the same position may be safely assumed. Though Huxley may reject Owen's theory of the vertebrate character of the segments of the cranium, because they are so very different from the segments in other parts of the column, the question rests entirely on the definition of a vertebra. If a vertebra be a segment of the skeleton, of course the skull is composed of vertebræ; if not, then the cranium may be said to be formed of "sclerotomes," or some other name may be used. Certain it is, however, that the parts of the segments of the cranium may be now more or less completely parallelised or homologised with each other, and that as we descend the scale of vertebrated animals, the resemblance of these segments to vertebræ increases, and the constituent segments of each become more similar. In the types where the greatest resemblance is seen, segmentation of either is incomplete, for they retain the original cartilaginous basis. Other animals which present cavities or parts of a solid support are still more easily reduced to a simple basis of segments, arranged either longitudinally (worm) or centrifugally (star-fish, etc.)

Each segment — and this term includes not only the parts of a complex whole but parts always subdivided, as the jaw of a whale or the sac-body of a mollusk, — is constructed, as is well known by cell division. In the growing fœtus the first cell divides its nucleus and then its whole outline, and this process repeated millions of times produces, according to the cell theory, all the tissues of the animal organism or their bases from first to last. That the ultimate or histological elements of all organs are produced originally by repetitive growth of simple, nucleated cells with various modifications of exactitude of repetition in the more complex, is taught by the cell theory. The formation of some of the tissues is as follows:

First Change—Formation of simple nucleated cells from homogeneous protoplasm or the cytoblastema.

Second—Formation of new cells by division of body and nucleus of the old.

Third—Formation of tissues by accumulation of cells with or without addition of intercellular cytoblastema.

A. In connective tissue by slight alteration of cells and addition of cytoblastema.

B. In blood, by addition of fluid cytoblastema (fibrin) to free cells (lymph corpuscles), which in higher animals (vertebrates) develop into blood-corpuscles by loss of membrane, and by cell development of nucleus.

C. In muscles by simple confluence of cells, end to end and mingling of contents (Kölliker).

D. Of cartilage by formation of cells in cytoblast which break up, their contents being added to cytoblast; this occurring several times, the result being an extensive cytoblast with few and small cells (Vogt). The process is here an attempt at development with only partial success, the result being a tissue of small vitality.

Even in repair-nutrition recourse is had to the nucleated cell. For Cohnheim first shows that if the corner of a frog's eye be scarified, repair is immediately set on foot by the transportation thither of white or lymph or nucleated corpuscles from the neighboring lymph heart. This he ascertained by introducing aniline dye into the latter. Repeated experiments have shown that this is the history in great part of the construction of new tissue in the adult man.

Now, it is well known that the circulating fluid of the fœtus contains for a period only these nucleated cells as corpuscles, and that the lower vertebrates have a greater proportion of these corpuscles than the higher, whence probably the greater facility for repair or reconstruction of lost limbs or parts enjoined by them. The invertebrates possess only nucleated blood corpuscles.

What is the relation of cell division to the forces of nature, and to which of them as a cause is it to be referred, if to any? The animal organism transfers the chemism of the food (protoplasm) to correlated amounts of heat, motion, electricity, light (phosphorescence), and nerve force. But cell division is an affection of protoplasm distinct from any of these. Addition to homogeneous lumps or parts of protoplasm (as in that lowest animal, *Protamœba* of Hæckel,) may be an exhibition of mere molecular force, or addition as is seen in the crystal, but cell division is certainly something distinct. It looks to me like an exhibition of another force, and though this is still an open question, it may be called for the present *growth force.* It is correlated to the other forces, for its exhibitions cease unless the protoplasm exhibiting it be fed. It is potential in the protoplasm of both protoplasmic animal mass and protoplasmic food, and becomes energetic on the union of the two. So long as cell division continues it is energetic; when cells burst and discharge the contained cytoblastema, as in the formation of cartilage, it becomes again potential.

The size of a part is then dependent on the amount of cell division or growth force, which has given it origin, and the number of segments is due to the same cause. The whole question, then, of the creation of animal and vegetable types is reduced to one of the amount and location of growth force.

Before discussing the influences which have increased and located growth force, it will be necessary to point out the mode in which these influences must necessarily have affected growth. Acceleration is only possible during the period of growth in animals, and during that time most of them are removed from the influence of physical or biological causes either through their hidden lives or incapacity for the energetic performance of life functions. These influences must, then, have operated on the parents, been rendered potential in their reproductive cells, and become energetic in the growing fœtus of the next generation. However little we may understand this mysterious process, it is nevertheless a fact. Says Murphy, "There is no act which may not become habitual, and there is no habit that may not be inherited." Materialized, this may be rendered—there is no act which does not direct growth force, and therefore there is no determination of growth force which may not become habitual; there is, then, no habitual determination of growth force which may not be inherited; and of course in a growing fœtus becomes at once energetic in the production of new structure in the direction inherited, which is acceleration.

III. THE INFLUENCES DIRECTING GROWTH FORCE.

Up to this point we have followed paths more or less distinctly traced in the field of nature. The positions taken appear to me either to have been demonstrated or to have a great balance of probability in their favor. In the closing part of these remarks I shall indulge in more of hypothesis than heretofore.

What are the influences locating growth force? First, physical and chemical causes; second, use; third, effort. I leave the first, as not especially prominent in the economy of type growth among animals, and confine myself to the two following. The effects of use are well known. We cannot use a muscle without increasing its bulk; we cannot use the teeth in mastication without inducing a renewed deposit of dentine within the pulp-cavity to meet the encroachments of attrition. The hands of the laborer are always larger than those of men of other pursuits. Pathology furnishes us with a host of hypertrophies, exostoses, etc., produced by excessive use, or necessity for increased means of performing excessive work. The tendency, then, induced by use in the parent is to add segments or cells to the organ used. Use thus determines the locality of new repetitions of parts already existing, and determines an increase of growth force at the same time, by the increase of food always accompanying increase of work done, in every animal.

But supposing there be no part or organ to use. Such must have been the condition of every animal prior to the appearance of an additional digit or limb or other useful element. It appears to me that the cause of the determination of growth force is not merely the irritation of the part or organ used by contact with the objects of its use. This would seem to be the remote cause of the deposit of dentine in the used tooth, in the thickening epidermis of the hand of the laborer, in the wandering of the lymph-cells to the scarified cornea of the frog in Cohnheim's experiment. You cannot rub the sclerotica of the eye without producing an expansion of the capillary arteries and corresponding increase in the amount of nutritive fluid. But the case may be different in the muscles and other organs (as the pigment cells of reptiles and fishes) which are under the control of the volition of the animal. Here, and in many other instances which might be cited, it cannot be asserted that the nutrition of use is not under the direct control of the will through the mediation of nerve force. Therefore I am disposed to believe that growth force may be, by the volition of the animal, as readily determined to a locality where an executive organ does not exist, as to the first segment or cell of such an organ already commenced, and that therefore effort is in the order of time, the first factor in acceleration.

Effort and use have, however, very various stimuli to their exertion.

Use of a part by an animal is either compulsory or optional. In either case the use may be followed by an increase of nutrition under the influence of reflex force or of direct volition.

A compulsory use would naturally occur in new situations which take place apart from the control of the animal, where no alternatives are presented. Such a case would arise in a submergence of land where land animals might be imprisoned on an island or in swamps surrounded by water, and compelled to assume a more or less aquatic life. Another case which has also probably often occurred, would be when the enemies of a species might so increase as to compel a large number of the latter to combat who would previously have escaped it.

In these cases the structure produced would be necessarily adaptive. But the effect would be most frequently to destroy or injure the animals (retard them) thus brought into new situations and compelled to an additional struggle for existence, as has, no doubt, been the case in geologic history. Preservation, with modifications would only ensue where the changes should be introduced very gradually. This mode is always a consequence of the optional use. The cases here included are those where choice selects from several alternatives, thus exercising its influence on structure. Choice will be influenced by the emotions, the imagination, and by intelligence.

As examples of intelligent selection the modified organisms of the varieties of bees and ants must be regarded as striking examples of its exercise. Had all in the hive or hill been modified alike, as soldiers, queens, etc., the origin of the structures might have been thought to be compulsory; but varied and adapted as the different forms are to the wants of a community, the influence of intelligence is too obvious to be denied. The structural results are obtained in this case by a shorter road than by inheritance.

The selection of food offers an opportunity for the exercise of intelligence, and the adoption of means for obtaining it still greater ones. It is here that intelligent selection proves its supremacy as a guide of use, and consequently of structure, to all the other agencies here proposed. The preference for vegetable or for animal food determined by the choice of individual animals among the omnivores, which were, no doubt, according to the palæontological record the predecessors of our herbivores, and perhaps of carnivores also, must have determined their course of life and thus of all their parts into those totally distinct directions. The choice of food under ground, on the ground, or in the trees would necessarily direct the uses of organs in those directions respectively.

Intelligence is a conservative principle and always will direct effort and use into lines which will be beneficial to its possessor. Thus we have the source of the fittest—*i.e.*, addition of parts by increase and location of growth force directed by the will—

the will being under the influence of various kinds of compulsory choice in the lower, and intelligent option among higher animals. Thus intelligent choice may be regarded as the originator of the fittest, while natural selection is the tribunal to which all the results of accelerated growth are submitted. This preserves or destroys them, and determines the new points of departure on which accelerated growth shall build.

Acceleration under the influence of effort accounts for the existence of rudimental characters. Many other characters will follow at a distance, the modifications proceeding in accordance with the laws here proposed, and retardation is accounted for by complementary or absolute loss of growth force.

Prof. GRAY, Prof. SWALLOW, Dr. HILGARD, Mr. PUTNAM, and others participated in the discussion of this paper.

THE following papers were also read in SECTION B, but the authors have failed to send us abstracts: —

A Theory on the Nature of the Difference in the Mental Capacity of High and Low Races of Men.— By Mr. RENAS DAVIS.
Observations on the Geology, Physical Features and Retrocession of Niagara Falls.— By Mr. GEORGE W. HOLLEY.
Contributions to Physigraphic and Dynamical Geology.— By Prof. RICHARD OWEN.
On the Phyllotaxis of the Cucurbitaceæ.— By Mr. H. W. RAVENEL.
Remarks on the Geology of the Mississippi Bottom.— By Dr. E. A. SMITH.
Remarks on the Catskill Red Sandstone Group as it occurs upon the borders of New York and Pennsylvania.— By Prof. JAMES HALL.
Remarks on the Snow Line in the Mountains of Montana.— By Prof. G. C. SWALLOW.
Some Observations on the Geology of Ohio.— By Prof. E. B. ANDREWS.
Notice of Tertiary Insects found by F. C. A. Richardson on the Green River in Wyoming.— By Prof. J. H. MCCHESNEY.
On Fossils and Minerals from North Carolina.— By Prof. W. C. KERR.

THE following were read by title only: —

The Classification of Echinoderms from their Microscopic Structure.— By Mr. A. AGASSIZ.
Observations on the Common Ground Worm.— By Mr. JAMES J. H. GREGORY.
Some Questions on Surface Geology.— By Prof. FRANK H. BRADLEY.
On the Entozoa Peculiar to Swine.— By Dr. W. B. FLETCHER.
On the Apparently One-ranked Phyllotaxis of Baptisia perfoliata.— By Mr. H. W. RAVENEL.
On the Geology of Northwestern Massachusetts.— By Prof. SANBORN TENNEY.
Remarks on the Cinnabar and other Minerals from California.— By Prof. J. LAWRENCE SMITH.
Remarks on the Abies Douglassii and a new Species, or a peculiar variety of Abies balsamifera of the Rocky Mountains.— By Prof. G. C. SWALLOW.
On some of the results in Geology and Palæontology of the Geological Survey of Ohio.— By Prof. J. S. NEWBERRY.
The Lignites of the West: their Geology and Economic value.— By Prof. J. S. NEWBERRY.
On the Homologies of the Rays of the Dorsal Fins of Polypterus.— By Prof. E. D. COPE.

THE following were given as lectures at the General Sessions held at Terre Haute: — "On the Fertilization of Flowers by Insect Agency," by Prof. ASA GRAY: "On the Pterosauria," by Dr. B. WATERHOUSE HAWKINS.

Dr. T. STERRY HUNT also delivered a lecture at Indianapolis, "On the Coal and Iron Resources of Indiana," and Prof. E. S. MORSE gave a lecture at a general session in Indianapolis, "On some of the Common Animals."

THE following papers, presented before SECTION A, were also of special interest to members of SECTION B: —

On the Rainfall in the United States.— By Prof. JOSEPH HENRY.
On the Dust Storm which occurred in Clinton Co., Ind., Dec. 24, 1870.— By Prof. J. TINGLEY.
On a new form of Boomerang in use among the Magni Puebla Indians of North America.— By Dr. C. C. PARRY.
The Character and Chemical Composition of the Meteorite that fell in May, near Searsmont, Me.— By Prof. J. LAWRENCE SMITH.

Description of the exact Locality of the immense masses of Meteoric Iron in Cahuila, Mexico, with the analysis of one recently discovered.—By Prof. J. LAWRENCE SMITH.

On Dentistry as practiced by the Romans 600 years B. C.—By Dr. EZRA READ.

THE following abstracts of remarks, made in connection with several papers, are of sufficient interest to print, though the papers to which they should have been appended do not appear owing to our failing to receive abstracts from their authors:—

Prof. E. W. HILGARD remarked, in the discussion of the paper by Dr. Smith on the "Mississippi Bottom," that his own observations in the Tensas bottom, in Louisiana, confirmed those of Dr. Smith. Much of the best land there, is a genuine prairie soil, full of calcareous concretions—a feature entirely foreign to the true river alluvium as well as the modern paludal deposits. These calcareous concretions appear to result from the maceration and dissolution of the fossil shells, as distinctly observed in several localities; and are very characteristic of the lower portion of the Port Hudson beds. There can be no doubt that a very large portion of the celebrated "alluvial" lands of the lower Mississippi are no alluvium at all, but substantially result from the disintegration of these older beds.

During the discussion on Prof. Andrews' paper on the "Geology of Ohio," the following remarks were made:—

Prof. A. WINCHELL remarked that he had examined the boulder-like stone taken by Professor Andrews from a coal bed in Ohio and felt very confident that it was a genuine boulder of Carboniferous times. The fragment showed that the rock had been a smoothed and rounded fragment of quartzite, composed of glassy and smurky grains of quartz, and that in every respect it was undistinguishable from surface boulders of Huronian quartzites, so abundant throughout the north. It was a very interesting phenomenon, since, so far as he remembered, it was the first instance of the discovery of a boulder in a bed of bituminous coal. It need not surprise us, however, because geologists well know that from the beginning to the end of the Coal-measure epoch, there were frequent intervals during which agencies existed which overspread portions of the sea-bottom with rounded quartzose fragments, evidently transported from the far north. Whatever these agencies were, it would not be unlikely that an occasional boulder should become mingled with the vegetable and alluvial materials quietly accumulating for the formation of a future bed of coal.

Dr. C. A. WHITE said he could not detect the presence of any hornblende in this piece of rock under his lens. It seems to be only a quartzite, similar masses of which he had often found in the coal-measures of Iowa. He had seen masses of quartzite imbedded in the very soft impure sandstones of the lower Coal-measures there, which had evidently been formed as quartzite just where they are, as the lines of stratification pass continuously through the soft sandstone and the quartzite lumps. The manner in which these quartzite masses, great and small, have originated need not now be discussed, but it is certain that they did originate where we now find them. He could not help regarding this mass as having a similar origin.

During one of the general discussions, Prof. A. H. WORTHEN said that the vertical range of the remains of the mammoth and mastodon is an interesting question; and bearing upon that I will relate the circumstances attending the discovery of the bones found between Illiopolis and Niantic, in Macon Co., in Illinois, in September, 1870. A farmer while digging a shallow well, to obtain water for the supply of stock, in a low peaty bog, at the depth of four feet below the surface, came upon what proved to be an entire tusk of a mastodon. This tusk was nine feet in length, and eight inches in diameter at the largest extremity, and entirely perfect. In addition to this, he obtained about two-thirds of the other tusk, the lower jaw, with the teeth all remaining in their places, the teeth of the upper jaw, and also some fragments of other bones of the same animal. With these were found a pair of the antlers of a large elk, with some other bones of the same animal, and also bones of the buffalo and deer. These were all embedded in a quicksand containing Physa, Planorbis, and Cyclas, of existing species, and beneath four feet of black peaty soil.

There are, in the Illinois State Collection, some other remains of this kind, which have been found in older deposits, among which are fragments of two mammoths found in true Drift, and bones of another specimen of mastodon found in the vicinity of Morris, in Grundy County, in undisturbed Drift, at a depth of eight feet below the surface, so that these extinct animals seemed to have lived in Illinois down to a comparatively recent period. At Alton, Illinois, a jaw of a mastodon, with both teeth remaining in place, was found at the base of the Loess, thirty feet below the surface.

THE meetings of SECTION B were well attended, and the members while feeling the necessity for fuller discussions of many papers, forebore to do so on account of the limited time for critical work in the section.

The officers of the section were Prof. C. G. SWALLOW of St. Louis, *Permanent Chairman;* Mr. J. E. EMERTON of Salem, *Secretary;* Professors COPE, MORSE and MARCY, *Sectional Committee.*

SUBSECTION (OF SECTION A.) MICROSCOPY.

THE Subsection of Microscopy renewed its organization by the election of the following officers: *Chairman*, Prof J. E. HILGARD of Washington; *Secretary*, Dr. W. W. BUTTERFIELD of Indianapolis; *Sectional Committee*, Messrs. WARD, BICKNELL and TUTTLE.

The attendance was smaller than at the two previous meetings, but the papers and discussions presented some points of unusual interest. The abstract of Prof. Ward's paper is the only one we have received in time for publication in this number.

Among the novelties of apparatus may be noticed the observation of the electric induction spark by the micro-spectroscope, by Prof. Vander Weyde; the oblique illumination of transparent objects under high powers by means of light reflected from a plane mirror lying upon the stage and directly beneath the mounted object—a little expedient of great practical convenience, also by Prof. Vander Weyde; the adoption of the Wenham Binocular arrangement by Zentmayer; and the somewhat general introduction into use of the eye-piece condensers with a wide horizontal illumination (for binoculars) upon the plan proposed by Prof. Ward at the Troy meeting last summer, and published in the NATURALIST of Dec., 1870. Mr. Bicknell places the stop-plate between the lenses of the condenser, instead of below them; and Prof. Ward, while retaining the eye-piece arrangement for use with low powers, for high powers combines the centring adjustment, Iris diaphragm, and stop-plate, with an achromatic combination of larger angle and more perfect corrections.

The committee on uniform standards in the powers of objectives and eye-pieces being unprepared to report, Messrs. Ward and Bicknell reported verbally, and the committee was continued until the next meeting. While an exact uniformity in the amplifying power of lenses in the same denomination is not to be looked for, it is believed that much of the existing confusion may be remedied. Many microscopists, the speakers among the number, have long been accustomed to alter the denomination of their lenses so as to represent, as nearly as practicable, their amplifying power when in actual use; and probably the principal makers in this country will freely coöperate with microscopists attaining this very desirable result. The introduction already partially accomplished, of a grading of the eye-pieces by comparison with equivalent single lenses, 2in., 1 in., ½ in., etc., may render this part of the subject, which seemed almost unattainable, the easiest and first to be accomplished. The remarks on the subject of powers will be given in a future number of the NATURALIST.

ON A NEW MICRO-TELESCOPE.—BY PROF. R. H. WARD.

THIS is designed especially for travelling and field use, but applicable to some of the daily work of the microscopist. It consists of a stand and accessories as follows: (A) An ordinary Tank Microscope having the body focussed by a rack and clamped at any desired height upon a stand like that of the bull's eye condensers. Probably few naturalists have any suspicion of the real usefulness of this little piece of apparatus, not only in the study of objects living in an aquarium or preserved in alcohol, glycerine, etc., but for the hasty inspection of herbarium specimens permanently fastened upon sheets of paper too large for the stage of an ordinary microscope, and for the preliminary examination of objects in jars, boxes, dissecting troughs, etc. The writer always keeps upon his working table such an instrument carrying a double nose-piece (the crooked form) and usually one-inch and three-inch objectives, and uses it continually and with great satisfaction as a substitute for a simple microscope. The brass foot-plate at the bottom of the upright pillar should be made somewhat larger and heavier than usual. (B) A Stage of convenient size and simple construction, sliding upon the upright pillar and capable of being clamped securely in any position. This stage carries a diaphragm and mirror below and stage forceps above, and enables the instrument to be used as a vertical compound microscope for ordinary work when, as in travelling or on a field-day, no more commodious stand may be available. This combination may also be used as a dissecting microscope, though for that purpose it is greatly preferable to use the Tank Microscope as a magnifier only, and to place the object, if opake, on the table, or if transparent, on the stage of any good dissecting microscope that may be within reach. (C) A Draw Tube sliding over the compound body from below, and capable of being fastened by a bayonet catch to the brass-work through which the compound body is moved by the rack. The objective in the compound body now acts as an erector, and another is to be screwed, by means of a large adapter, into the lower end of the Draw Tube, to act as the objective.